



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

June 8, 2022

Mr. John Dent, Jr.
Vice President-Nuclear and
Chief Nuclear Officer
Nebraska Public Power District
72676 648A Avenue
Brownville, NE 68321

SUBJECT: COOPER NUCLEAR STATION – PROPOSED INSERVICE INSPECTION
ALTERNATIVE RR5-01 REVISION 1 (EPID L-2021-LLR-0046)

Dear Mr. Dent:

By letter dated June 21, 2021, as supplemented by letter dated February 7, 2022, Nebraska Public Power District (the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for the use of an alternative to certain requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, at Cooper Nuclear Station (Cooper).

Specifically, the licensee proposed an alternative to install a full structural weld overlay (FSWOL) on the control rod drive nozzle cap weld at Cooper during refueling outage 32. The licensee stated that this alternative would only be used as a contingency in the event that a flaw is discovered that would result in the need for a FSWOL. Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(z)(1), the licensee requested to use the proposed alternative on the basis that the alternative provides an acceptable level of quality and safety.

As set forth in the enclosed safety evaluation, the NRC staff has reviewed the subject request and determined that the proposed alternative demonstrates an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the use of RR5-01, Revision 1, at Cooper, as a contingency for a flaw that may be discovered during refueling outage 32. The proposed alternative is authorized for the fifth 10-year inservice inspection interval, which began on April 1, 2016, and is scheduled to end on February 28, 2026.

All other ASME Code, Section XI requirements for which an alternative was not specifically requested and approved remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

J. Dent, Jr.

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If you have any questions, please contact the Cooper Project Manager, Thomas J. Wengert, at 301-415-4037 or by email to Thomas.Wengert@nrc.gov.

Sincerely,

Jennifer L. Dixon-Herrity, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-298

Enclosure:
Safety Evaluation

cc: Listserv

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ALTERNATIVE RR5-01 REVISION 1 (EPID L-2021-LLR-0046) DATED
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UNITED STATES
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST RR5-01, REVISION 1

ALTERNATIVE WELD OVERLAY REPAIR FOR A DISSIMILAR

METAL WELD JOINING NOZZLE TO CONTROL ROD DRIVE END CAP

NEBRASKA PUBLIC POWER DISTRICT

COOPER NUCLEAR STATION

DOCKET NO. 50-298

1.0 INTRODUCTION

By letter dated June 21, 2021 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21172A301), as supplemented by letter dated February 7, 2022 (ML22039A072), Nebraska Public Power District (the licensee) requested the use of an alternative (RR5-01, Revision 1) to certain requirements of Section XI of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (ASME Code) for the fifth 10-year inservice inspection (ISI) interval at Cooper Nuclear Station (Cooper). The licensee proposed an alternative to install a full structural weld overlay (FSWOL) on the control rod drive nozzle cap weld at Cooper during refueling outage 32. The licensee stated that this alternative would only be used as a contingency in the event that a flaw is discovered that would result in the need for a FSWOL.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(z)(1), the licensee requested to use the proposed alternative on the basis that the proposed alternative will provide an acceptable level of quality and safety.

2.0 REGULATORY EVALUATION

Adherence to Section XI of the ASME Code is mandated by 10 CFR 50.55a(g)(4), "Inservice inspection standards requirement for operating plants," which states, in part, that ASME Code Class 1, 2, and 3 components will meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in the ASME Code, Section XI.

The regulations in 10 CFR 50.55a(z), "Alternatives to codes and standards requirements," state that

Alternatives to the requirements of paragraphs (b) through (h) of [10 CFR 50.55a] or portions thereof may be used when authorized by the Director, Office of Nuclear Reactor Regulation. A proposed alternative must be submitted and authorized prior to implementation. The applicant or licensee must demonstrate that:

(1) "Acceptable level of quality and safety." The proposed alternative would provide an acceptable level of quality and safety; or

(2) "Hardship without a compensating increase in quality and safety." Compliance with the specified requirements of this section would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Based on the above, and subject to the following technical evaluation, the U.S. Nuclear Regulatory Commission (NRC) staff finds that regulatory authority exists for the licensee to request the use of an alternative, and the NRC to authorize the proposed alternative.

3.0 TECHNICAL EVALUATION

3.1 Licensee's Request for Alternative

3.1.1 ASME Code Components Affected

ASME Code Class:	Class 1
Examination Category:	B-F
Item Number:	B5.10
Components Numbers:	RCA-BF-1, 5 inch Control Rod Drive Return Cap-to-Nozzle N9 Weld

3.1.2 Applicable ASME Code Requirements

ASME Code, Section XI, 2007 Edition through the 2008 Addenda.

3.1.3 Licensee's Basis for Request and Proposed Alternative

ASME Code, Section XI, article IWA-4000, "Repair/Replacement Activities" provides requirements for repair or replacement of Class 1, 2, 3 components. Subarticle IWA-4400, "Welding, Brazing, Metal Removal, Fabrication, and Installation," provides requirements for repair/replacement of Class 1, 2, or 3 components by welding.

ASME Code, Section XI, paragraph IWA-4411, requires repair/replacement activities to be performed in accordance with the owner's requirements and the original construction code of the component or item. Alternatively, subparagraphs IWA-4411(a) and (b) allow use of later editions/addenda of the construction code, either in its entirety or portions thereof, code cases, and revised owner requirements. Subparagraph IWA-4411(e) permits the use of subarticle IWA-4600(b) when welding is to be performed without postweld heat treatment (PWHT) required by the construction code. Subparagraph IWA-4411(h) permits the use on

nonmandatory appendix Q for the installation of welded overlays for the repair of stress corrosion cracking (SCC) in Class 1, 2, or 3 austenitic stainless steel pipe weldments.

ASME Code, Section XI, subsubarticle IWA-4190(a) requires code cases used for repair/replacement activities to be applicable to the edition and addenda of ASME Code, Section XI, specified for the activity. Subarticle IWA-4600(b) provides temper bead welding requirements in accordance with subsubarticles IWA-4620, "Temper Bead Welding of Similar Materials"; IWA-4630, "Temper Bead Welding of Dissimilar Materials;" and IWA-4640, "Cladding," as an alternative to the welding and PWHT requirements of the construction code. NRC-approved code cases may also be used as an alternative to the welding and PWHT requirements of the construction code.

ASME Code Case N-638-7, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW [Gas Tungsten Arc Welding] Temper Bead Technique, Section XI, Division 1," may be used as an alternative to subarticle IWA-4600(b). This code case is listed in Revision 19 of Regulatory Guide (RG) 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," dated October 2019 (ML19128A244), and can be used under the condition that ultrasonic testing examination of a representative sample of the repaired volume with construction-type flaws can be demonstrated. ASME Code Case N-638-7 provides procedure qualification requirements for temper bead welding of similar and dissimilar metal weld joints using an automatic or machine GTAW technique.

Mandatory appendix VIII, supplement 11, provides procedure and personnel qualification requirements for examination of full structural overlaid wrought austenitic piping welds and is required by nonmandatory appendix Q.

The licensee stated that the control rod drive return line cap-to-nozzle weld is a dissimilar metal weld, which is considered susceptible to SCC and is classified as category D in Boiling Water Reactor Vessel Internals Project (BWRVIP)-75A, "BWR [Boiling Water Reactor] Vessel and Internals Project Technical Basis for Revisions to Generic Letter 88-01 Inspection Schedules." In this report, category D welds are defined as welds that are susceptible to intergranular SCC (IGSCC), which have not been treated with an IGSCC remedy, but for which cracks have not been reported. In the submittal dated June 21, 2021, the licensee stated that previous examinations of this component have not identified any relevant indications. If the licensee were to identify a condition during refueling outage 32 which requires repair of this component, the methods currently available within ASME Code, Section XI, do not provide techniques to support a repair without draining the reactor vessel. The licensee has proposed a contingency plan to perform a FSWOL, as specified by nonmandatory appendix Q, for the repair of Class 1 austenitic stainless steel pipe weldments, if SCC is found during refueling outage 32. The FSWOL would be made using SCC-resistant alloy 52M weld material.

The licensee also stated that, because ASME Code, Section XI, nonmandatory appendix Q does not specifically apply to the overlay of dissimilar metal welds, and the requirements of subarticle IWA-4600(b) or ASME Code Case N-638-7 do not specifically apply to the welding of overlays, an alternative is required to combine the requirements of nonmandatory appendix Q and ASME Code Case N-638-7 to provide a complete set of requirements for a FSWOL of the control rod drive return line cap-to-nozzle weld.

Nonmandatory appendix Q is applicable to weld overlays of austenitic stainless steel material. Nonmandatory appendix Q, paragraph Q-2000(a) requires that the reinforcement weld metal be low carbon (0.035 percent maximum) austenitic stainless steel and nonmandatory appendix Q,

paragraph Q-2000(d), requires the first two layers of the weld overlay to have a ferrite content of at least 7.5 FN (Ferrite Number). Because the proposed overlay is a fully austenitic nickel-based alloy (Alloy 52M) overlaying an SA 508 Class 2 nozzle, Alloy 82 and 182 weld materials, and an SB-166 cap, nonmandatory appendix Q, paragraph Q-2000(a) and (d) cannot be applied to this repair.

The licensee further noted that ASME Code Case N-638-7, paragraphs 4(a), and 4(a)(4) state that all welds (including repair welds) shall be volumetrically examined in accordance with the requirements and acceptance criteria of the construction code or ASME Code, Section III. An alternative is required for this portion of the code case because the licensee intends to use the examination requirements of paragraph Q-4100 of ASME Code, Section XI, nonmandatory appendix Q.

The licensee proposed a contingency to repair the component identified in table 1 below, if necessary, to mitigate any relevant indications related to SCC that may be identified during refueling outage 32. This repair would consist of a FSWOL to replace the original pressure boundary of the dissimilar metal weld.

Table 1

Component Identification	Component Description	Material 1	Material 2	Maximum Surface Area of Weld Overlay (Ferritic side, square inches)
RCA-BF-1	5 inch Control Rod Drive Return Cap-to-Nozzle N9 Weld	Nozzle: A-508 Class 2 (low alloy steel)	SB-166 (Inconel Alloy 600)	260 square inches on the ferritic side

The licensee proposed to use ASME Code Case N-638-7 and nonmandatory appendix Q to install a weld overlay on a configuration that would consist of an A-508, Class 2 low alloy steel nozzle, Alloy 182/82 weld materials, and an SB-166, Alloy 600 nickel alloy cap using ERNiCrFe-7A (Alloy 52M) filler metal in lieu of the requirements in nonmandatory appendix Q that apply to austenitic stainless steel piping and weldments.

As an alternative to nonmandatory appendix Q, paragraph Q-2000(a) and (d), the licensee proposed to perform the weld overlay using purely austenitic ERNiCrFe-7 A (Alloy 52M), making the requirements in these paragraphs not applicable.

In its letter dated June 21, 2021, the licensee provided the following description of the overlay:

The weld overlay will extend around the full circumference of the end cap to nozzle weldment location in accordance with Nonmandatory Appendix Q. The overlay length will extend across the projected flaw intersection with the outer surface beyond the extreme axial boundaries of the flaw. The design thickness and length will be determined in accordance with the guidance provided in Nonmandatory Appendix Q (paragraph Q-3000(a)) and ASME Section XI, paragraph IWB-3640, 2007 Edition through the 2008 Addenda for the evaluation methodology for flawed pipe. The overlay will completely cover the area of the flaw and other Alloy 182 or susceptible austenitic stainless steel material with the

highly resistant Alloy 52M weld filler material. The overlay length will conform to Nonmandatory Appendix Q, paragraph Q-3000(a), which satisfies the stress and load transfer requirements.

3.1.4 Duration of Proposed Alternative

The proposed alternative will be used for the fifth 10-year ISI interval at Cooper.

3.2 NRC Staff Evaluation

The application of this FSWOL is subject to the welding repair requirements in ASME Code, Section XI, subarticle IWA-4400. Subparagraph IWA-4411(e) allows for the use of subarticle IWA-4600(b), which provides temper bead welding requirements as an alternative to the welding and postweld heat treatment requirements of the construction code. As an alternative to subarticle IWA-4600(b) the licensee chose to invoke ASME Code Case N-638-7. As stated earlier, ASME Code Case N-638-7 is listed in Revision 19 of RG 1.147 as conditionally acceptable. The licensee confirmed in its letter dated June 21, 2021, that it will implement the associated condition as follows:

Demonstration for ultrasonic examination of the repaired volume is required using representative samples which contain construction type flaws.

Subsubarticle IWA-4190(a) requires that code cases used for repair/replacement activities to be applicable to the edition and addenda specified for the repair/replacement activity. In the Applicability Index for ASME Section XI code cases, use of ASME Code Case N-638-7 with the 2007 Edition through the 2008 Addenda is considered acceptable. Therefore, the NRC staff finds that the licensee's use of ASME Code Case N-638-7 is applicable for this proposed overlay.

The licensee proposed to use a modified version of ASME Code, Section XI, Nonmandatory appendix Q for this potential FSWOL repair. Nonmandatory appendix Q is applicable to the FSWOL of austenitic stainless steel material (per Article Q-1000) using austenitic stainless steel weld material [per articles Q-2000(a) and (d)] and contains design considerations (article Q-3000) and ultrasonic examination requirements (article Q-4000). However, as an exception to the low carbon austenitic stainless steel weld metal requirement of article Q-2000(a) and the minimum delta ferrite requirement of article Q-2000(d), this proposed alternative will have the overlay fabricated with austenitic nickel-based ERNiCrFe-7A (Alloy 52M) and deposited without a delta ferrite phase over a dissimilar metal weld. The NRC staff finds the licensee's request to use nonmandatory appendix Q with the above exceptions for the proposed alternative to be acceptable because the design considerations and the ultrasonic examination requirements of appendix Q can be applied to the dissimilar metal weld combination of the proposed alternative and will result in a FSWOL with sufficient structural integrity to mitigate the detrimental impact of SCC, if found.

ASME Code, Section XI, mandatory appendix VIII, provides procedure and personnel qualification requirements for ultrasonic examination and is required by nonmandatory appendix Q. Supplement 11 to mandatory appendix VIII is applicable to full structural overlaid wrought austenitic piping welds but is not applicable to FSWOL of dissimilar metal welds. As an alternative to mandatory appendix VIII with supplement 11, the licensee proposed to use the Electric Power Research Institute (EPRI) Performance Demonstration Initiative (PDI) qualification program, as described in the licensee's submittal. Table 2 of the licensee's

submittal dated June 21, 2021, provides a comparison between the requirements in mandatory appendix VIII, supplement 11 and the PDI program. The NRC staff has determined that the PDI program for qualifying procedures, equipment, and personnel as described in the submittal, is applicable to overlays of dissimilar metal welds and is very similar to the requirements in mandatory appendix VIII, supplement 11. Minor differences between the two documents have no significant bearing on procedure and personnel qualification. Therefore, the NRC staff finds that the use of EPRI's PDI qualification program is acceptable.

In the event that a flaw is discovered that will require a FSWOL repair, the licensee stated that a sizing analysis and design drawing will be developed and made available to the NRC prior to installation of the overlay. Furthermore, a complete qualification package will be created within 120 days after the outage and will include a design report for the repair and a fracture mechanics analysis to confirm that identified or conservatively postulated flaws comply with ASME Code, Section XI compliance beyond the next scheduled inspection. The identified or postulated flaws in the fracture mechanics analysis will be evaluated in the axial and circumferential directions and consider growth due to both stress corrosion and fatigue cycling. The licensee confirmed that the qualification package as well as the preservice examination results for the overlay will be made available to the NRC. Submittal of the sizing analysis, design drawing, qualification package, and preservice examination results will allow the NRC staff to verify that the FSWOL is installed properly, and that flaw growth will be adequately mitigated during continued operation.

The licensee stated that the control rod drive return line cap-to-nozzle weld is a dissimilar metal weld that is not resistant to IGSCC and has had no mitigating stress improvements performed on it. The weld contains Alloy 82 and 182 weld materials, which are known to be susceptible to IGSCC due to their relatively low content of IGSCC-resistant chromium. The licensee proposed to apply a FSWOL with austenitic nickel-based Alloy 52M to the subject weld if any indications related to SCC were found during refueling outage 32. Alloy 52M contains nominally 28 percent chromium, which provides enhanced resistance to corrosion as compared to Alloys 82 and 182, which contain nominally 20- and 15-percent chromium, respectively. The overlay would cover alloy steel (SA-508 Class 2) base metal, Alloy 82/182 weld metal, and Alloy 600 base metal. There is no ASME Code section or code case with requirements related to a FSWOL with these materials, however it is generally accepted that Alloy 52M is compatible with this material selection, and that the ASME Code would permit this overlay as long as the welding procedure is properly qualified.

The NRC staff finds that the licensee's proposed FSWOL follows the design requirements of nonmandatory appendix Q, except for the alternatives that were previously discussed and will serve as an acceptable repair for any SCC-related indications that may be found during the fifth 10-year ISI interval. The NRC staff concludes that Alloy 52M with its high chromium content is an acceptable material for the overlay and will provide superior corrosion resistance to the Alloy 82 and 182 weld materials in the existing weld. The NRC staff finds that it is acceptable to utilize the temper bead welding guidance in ASME Code Case N-638-7 because the licensee agreed to meet the condition of use set forth in RG 1.147, Revision 19. Lastly, the welding for the proposed alternative will be performed and qualified in accordance with ASME Code requirements, including material selection, overlay design, personnel, and post weld examinations. Therefore, the NRC staff finds that the proposed alternative provides an acceptable level of quality and safety, and structural integrity.

4.0 CONCLUSION

As set forth above, the NRC staff determines that the proposed alternative demonstrates an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the use of RR5-01, Revision 1, at Cooper as a contingency for a flaw that may be discovered during refueling outage 32. The proposed alternative is authorized for the fifth 10-year ISI interval, which began on April 1, 2016, and is scheduled to end on February 28, 2026.

All other ASME Code, Section XI requirements for which an alternative was not specifically requested and approved remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: A. Young, NRR

Date: June 8, 2022